THE EFFECT OF OUTDOOR-REARING AND BREED-CROSS ON CARCASS COMPOSITION AND TECHNOLOGICAL MEAT QUALITY IN PIGS

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BACKGROUND AND OBJECTIVES

The slaughter pig production in Sweden today is based on the concept of using crossbreeding and almost all slaughter pigs are crossbred. The sow is usually a cross between Landrace and Yorkshire, and the sire-breed is Hampshire for 70% of these, while 20% have Duroc as terminal sire and the rest are white crosses. Few studies have been done to compare Hampshire- and Duroc-crosses. So far they have usually been compared with the white breeds. The quality of pig meat, expressed as either carcass composition, technological quality or sensory quality, is determined by both the genetic background of the animals, and the environmental factors during rearing. The increased interest for meat from a more ethical animal production has led to an increased number of farms which rear pigs in alternative systems, for example outdoors or in larger groups with more space than in small pens. So far, little research has been carried out concerning the effects of outdoor-rearing. The purpose of this investigation was to study the effect of outdoor-rearing and sire-breed on carcass composition and technological meat quality.

METHODS

Animals: The animals used were 120 crossbred slaughter pigs with Yorkshire or Yorkshire x Landrace sows and Duroc, Hampshire or Yorkshire as terminal sire. Each litter was split into two, one half was reared outdoors in a 0.03 km^2 area, the other was reared indoors. The indoor-rearing was performed as one group on straw in a non-isolated building (120 m^2). Both groups were fed *ad libitum*, using a feedstuff with a normal energy- and protein level. The pigs were slaughtered and graded in a commercial slaughterhouse, at a weight of 100 kg.

Carcass composition: The carcasses were cut in ham, back, shoulder and belly according to Andersson (1980). The ham and back were defatted and the weights of meat+bone and fat were recorded. In addition, the loin and ham were dissected into the following muscles: *M. longissimus dorsi* (LD), *M. biceps femoris* (BF), *M. semimembranosus et adductor* (SMA), *M. quadriceps femoris* (QF), *M. semitendinosus* (ST) and *M. gluteus* (GLU).

Technological meat quality: These measurements were carried out at cutting, at the last rib in LD and in the central part of the SMA and BF. Meat colour, ultimate pH (pH_u) and waterholding capacity (WHC) were measured according to Enfält et al. (1994). Shear force measurements were made with the Warner Bratzler apparatus on muscles aged for 4 days before freezing. Samples were boiled to an internal temperature of 72 °C, and the cooking losses were determined. Glycolytic potential (GP) was defined by Monin and Sellier (1985) as: GP = 2([glycogen] +[glucose]+[glucose-6-phosphate]) + [lactate], and is expressed in µmol/g of fresh tissue. Intramuscular fat content (IMF) was analysed with the SBR method, and a subjective scoring was also carried out, using the levels from 1 (no marbling) to 5 (high marbling). Napole yield in LD was analysed according to Naveau (1986) and crude protein was analysed with the Kjeltec apparatus (Tecator AB, Höganäs, Sweden).

Statistical analysis: The statistical analysis was carried out with the Statistical Analysis System (SAS Institute, 1991, 1994), using the GLM-procedure.

RESULTS AND DISCUSSION

The results are presented in Table 1, and generally they showed that the sire-breeds differed in technological quality, while the rearing form influenced the carcass composition. There were no breed differences found in any of the carcass composition traits, which is very interesting, as most of the earlier studies performed have showed that Duroc has been less meaty than Yorkshire or Landrace (Cameron, 1990; Edwards et al., 1992; Enfält et al., 1995). However, McGloughlin et al. (1988) found heavier shoulder and ham in Duroc compared to Large White and Landrace. It seems likely that the selection for leaness in the Duroc breed has succeded to lower the gap betweeen this breed and the white breeds. This has also been found in the Swedish breeding evaluation, showing similar leanness for Duroc-crosses and white crosses (Alarik, personal communication). The lack of difference in IMF content between breeds in this study supports this similarity in leaness. Lundeheim et al. (1995) found no difference between Hampshire and Yorkshire in leanness. So far in Sweden, Duroc and Hampshire, as sire breeds, have been compared only to the white breeds and not to each other, but Martel et al. (1988) compared all four breeds. In general they found small breed differences, but Hampshire and Duroc had somewhat leaner ham than Landrace and Yorkshire.

The technological meat quality differed between the sire-breeds, where Hampshire had significantly lower pH_u in BF and SMA, lower crude protein content and Napole yield in LD, higher drip loss and cooking loss in BF, and more water and higher GP in LD. This is in agreement with Lundström et al. (1996), who found these effects in Hampshire-crosses carrying the dominant RN-gene, when carriers and non-carriers were compared. All but three of the Hampshire-crosses in the present material had a high GP (>180µmol/g ww), indicating that they all carried the RN-gene. This is possible, since the gene frequency is high in the Swedish Hampshire population (Enfält et al. 1994). Yorkshire had the highest shear force value, indicating a less tender meat, which is in agreement with earlier findings (Essén-Gustavsson & Fjelkner-Modig, 1985).

The outdoor- reared pigs had greater opportunity to move and they were found to have a lower daily gain and feed consumption (Lundeheim, 1996). This lower intensity might explain the higher leaness in this group, which also was found by Enfält et al. (1995). We could however not find any effect of rearing form on the size of individual muscles, which is in accordance with Enfält et al. (1993).

The indoor-reared pigs in the present study had a greater possibility to move than in a conventional pen. The difference between the two rearing forms was therefore not great enough to give any changes in the technological quality, except for crude protein,which was somewhat higher for the indoor-reared pigs. This is in accordance with van der Waal et al. (1993) who did not find any effect of outdoor rearing on pH and WHC. A greater difference between raising forms can cause differences in pH, with a lower pH_u for outdoor-reared pigs (Barton-Gade & Blaaberg, 1989). This difference might be explained by a capacity to utilize other substrates than glycogen during the transport to the slaughterhouse, thus providing more glycogen when the *post-mortem* glycolysis is carried out. A lower pH can then give a lower WHC and lighter meat.

CONCLUSIONS

Outdoor-rearing produced carcasses with higher lean meat content, but had no effect on the technological quality. The three sire-breeds studied did not differ in carcass composition, but the Hampshire-sired pigs gave meat with lower pH_u, crude protein and Napole yield, and higher drip loss, cooking loss, GP and water.

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Table 1. Least-squares means for carcass composition and technological meat quality, and level of significance between sire-breeds and rearing form

Variable		Sire breed: Yorkshire	Hampshire	Duroc	Level of sign.	Rearing form: Indoor	Outdoor	Level of sign.
Sidefat thickness, mm		17.8	16.5	17.5	n.s.	18.5	16.0	***
Meat at grading, %		58.2	58.9	58.3	n.s.	57.8	59.1	**
Meat+bone in back+ham[1], %		31.2	37.6	36.8	n.s.	36.5	37.9	***
Meat+bone in ham[1], %		25.0	24.9	24.5	n.s.	24.4	25.3	***
Fat in ham[1], %		7.3	7.1	7.5	n.s.	7.6	7.0	***
Crude protein, %		20.8^{a}	20.1^{b}	21.1^{a}	***	20.8	20.5	*
Dry matter, %		25.5^{a}	24.6^{b}	25.5^{a}	**	25.2	25.1	n.s.
Glycolytic potential, µmol/g		148.4^{a}	215.2^{b}	159.0^{a}	***	171.4	177.1	n.s.
IMF, subjective score		2.1	1.8	2.1	n.s.	2.2	1.8	n.s.
IMF, %		1.8	1.8	1.4	n.s.	1.8	1.5	n.s.
pH	LD	5.50	5.46	5.46	n.s.	5.48	5.47	n.s.
	BF	5.52^{a}	5.49^{b}	5.54^{a}	**	5.52	5.51	n.s.
	SMA	5.51^{a}	5.47^{b}	5.51^{a}	**	5.50	5.50	n.s.
Drip loss, %	LD	4.6	5.1	5.1	n.s.	4.9	4.9	n.s.
	BF	3.0^{a}	3.8^{b}	3.1^{ab}	*	3.3	3.3	n.s.
Cooking loss, %	LD	22.5^{ab}	25.0^{a}	21.4^{b}	*	23.0	22.9	n.s.
	BF	29.4^{a}	32.6^{b}	29.4^{a}	**	29.8	31.1	n.s.
Shear force, kg/cm^{2}	LD	4.1^{a}	3.7^{b}	4.0^{ab}	#	3.9	4.0	n.s.
	BF	4.4^{a}	3.9^{b}	4.3^{ab}	*	4.1	4.3	n.s.

[1]In percentage of carcass weight. Means with the same letter are not significantly different (p>0.05).
Level of significance: n.s. p>0.10; # p≤0.10; * p≤0.05; ** p≤0.01; *** p≤0.001.